A Possible "Defense" Response in a Commensal Polychaete

BY

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(Plate 4)

INTRODUCTION

The keyhole limpet *Diodora aspera* (Eschscholtz, 1833) is one of a diverse group of hosts (Pettibone, 1953) for the commensal polynoid *Arctonoe vittata* (Grube, 1855). This limpet occurs on rocks in the low intertidal zone of open coasts from Alaska to Lower California (Ricketts & Calvin, 1962). Limpets, 50 - 60 mm long, may have commensal *A. vittata* as long as 50 - 70 mm inhabiting the mantle cavity. Palmer (1968) has reported a frequency of infestation of 0.8 to 1.0 worms per host limpet.

Margolin (1964) reported a distinct mantle response from *Diodora aspera* which he suggested is a possible deterrent against predation by sea stars. This escape response thus might help protect both the limpet and its commensal from predation. In this paper we report a biting response by commensal *Arctonoe vittata* toward potential asteroid predators which might in turn afford an added measure of protection to the symbionts.

MATERIALS and METHODS

Diodora aspera with commensals were collected during a series of minus tides during August and September, 1968, from the Edward's Reef area on the southwest side of San Juan Island, Washington. The common intertidal asteroid, *Pisaster ochraceus* (Brandt, 1835), was used as the principal test animal for the determination of the *Arctonoe* response. In addition, the reaction of commensal *A. vittata* to *Evasterias troschelii* (Stimpson, 1862) and *Pycnopodia helianthoides* (Brandt, 1835), two typically subtidal sea stars, was tested. All animals were maintained in aquaria with running sea water at the Friday Harbor Laboratories.

The procedure for observing the biting response consisted of placing a single *Diodora* containing a commensal in an enameled tray of fresh sea water. The limpet was left undisturbed in the tray until it had relaxed and was moving about on its foot. An arm of a test star was then brought into contact with the limpet in such a way that the extended tubefeet contacted the lateral or posterior shell-mantle junction. Keeping the rest of the sea star free of the test site allowed observation of both the symbionts. The trial period for these experiments was 10 minutes.

The behavior of isolated *Arctonoe vittata* toward *Pisaster ochraceus* was examined by merely placing single worms in contact with a sea star in a tray of sea water.

To determine whether the mantle response of *Diodora* results in the release of some substance which affects the behavior of *Arctonoe vittata* toward *Pisaster,* individual *Arctonoe* were removed from *Diodora* and placed next to a *Pisaster* at one end of a 12-inch plastic tray. A *Diodora* was then placed at the other end of the tray and the mantle response elicited by a sea star. Sea water was allowed to flow over the *Diodora* toward an outlet at the end of the tray having the *Arctonoe* and *Pisaster.*

The necessity for the sea star's presence in eliciting the response of the commensal *Arctonoe* was examined by subjecting individual limpets with their commensals to sea water in which sea stars had been maintained prior to testing. In these experiments *Pisaster* and *Pycnopodia,* large enough to displace 500 ml, were placed in individual beakers of 4000 ml capacity, with aerated sea water for 27 hours. The *Diodora* were placed in individual glass

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dishes (150 ml capacity) of fresh sea water for 5 minutes prior to testing. For each test the water in the dish was replaced with "sea star water" and the activity of the limpets and commensals recorded during the 10 minute trial period.

The feeding experiments were conducted in a 22 inch by 82 inch Lucite tank 22 inches deep and divided into two equal compartments. Ten *Diodora* containing *Arctonoe vittata* were placed in one compartment (I) and 10 lacking *Arctonoe* in the other (II). In the first experiment 3 *Pisaster ochraceus* (starved 3 days) of similar size were placed in each compartment. In the second experiment 2 *Pycnopodia helianthoides* of similar size were placed in each compartment. Natural lighting conditions illuminated the outdoor tank.

RESULTS

The Biting Response

Contact between *Pisaster ochraceus* tubefeet and the *Diodora aspera* mantle edge immediately evoked the "mantle response" described by MARGOLIN (1964). In several preparations, activity of *Arctonoe vittata* was observed within 15 seconds after initiation of the mantle response. The first evidence of the activity of *Arctonoe* usually consisted of observing the dark tipped palps of the worm extending slightly past the mantle margin. This initial behavior occurred whether or not the worm's head was in the immediate vicinity of the tubefoot contact.

Next, the worm usually would extend itself about 1 cm from the edge of the host shell (Plate 4, Figure 1). If the worm emerged away from the point of sea star contact, it "searched" the immediate area with probing movements. Such a worm would usually move around the perimeter of the shell toward the point of tubefoot contact. This movement could be accomplished either by moving while extended or by retracting under the mantle and emerging in the vicinity of the sea star's contact.

In the vicinity of the tubefeet, the worm intensified its searching behavior until actual contact was effected with a tubefoot. At this point the worm typically explored the tubefoot by moving its head up and down the length of the foot with a palp on each side. Following this exploration the worm rapidly everted its armed proboscis and bit the tubefoot (Plate 4, Figure 2).

Several modifications in this behavior occurred. Occasionally the worm would emerge from under the shell upside down. A number of worms were observed to bite the sea star deep in the ambulacral groove rather than simply on an exposed tubefoot. In one instance an *Arctonoe vittata* bit an *Evasterias troschelii* on the lateral margin of one ray well above the ambulacral groove.

The response usually was completed within 2 - 3 minutes following contact between *Pisaster* tubefeet and the *Diodora*. Single bites occurred most frequently, but occasionally repeated biting occurred during the 10 minute experimental period.

The usual result of the biting behavior was the immediate withdrawal of the tubefeet in the vicinity of the worm, often including any tubefeet attached to the host's shell. A bite on the side of a ray frequently resulted in the sea star's bending the ray away from the point of biting. At no time during these experiments did we see a tubefoot severed nor did any worm exhibit a response to an excised tubefoot held in forceps or a torn tubefoot on the bottom of the tray.

Pisaster ochraceus consistently elicited more biting responses from *Arctonoe vittata* than did either *Evasterias troschelii* or *Pycnopodia helianthoides*. In a series of 10 trials with each species, *Arctonoe* bit *Pisaster* 8 times while biting both *Evasterias* and *Pycnopodia* 2 times each.

The Behavior of Isolated *Arctonoe vittata* toward *Pisaster ochraceus*

When placed in contact with the tubefeet of *Pisaster ochraceus, Arctonoe* removed from host limpets wandered among the tubefeet and occasionally wrapped themselves around the tip of a ray. In a series of 10 such trials the only adverse interaction observed between the two species consisted of the sea star's pedicellariae impeding the attempts of *Arctonoe* to climb onto a ray. At no time did an isolated *Arctonoe* bite a sea star.

There was no observable change in the behavior of isolated *Arctonoe* toward *Pisaster* when the commensals and sea stars were placed together in the effluent from a *Diodora* which was being harassed by a second *Pisaster*. Though this experiment was repeated only 3 times, it suggests that a water transportable substance is not released from *Diodora* during the mantle response which might modify *Arctonoe*'s behavior toward *Pisaster*.

The Response to "Sea Star Water"

In a series of 10 trials in which water from *Pycnopodia* was used, no mantle response of the limpets was observed nor did any commensal *Arctonoe* become active. The addition of water in which *Pisaster* had been maintained elicited a very slight mantle response from *Diodora* in 9 trials and a pronounced response, approximately one-half the response to direct tubefoot contact, in one limpet.

Figure 1

Arctonoe vittata extended from the mantle cavity of *Diodora aspera* and approaching the tubefeet of *Pisaster ochraceus.*

Figure 2

The rapid eversion of its armed proboscis by *Arctonoe vittata* immediately prior to biting a tubefoot of *Pisaster ochraceus.*